A study on the development and application of a measuring tool for the assessment of medical equipment management system (MEMS) performance in public hospitals, with a focus on the indian context

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Abstract:

The creation and implementation of a thorough assessment instrument to evaluate the effectiveness of MEMS in Indian public hospitals is the main goal of this project. The goal was to develop a standardised methodology that uses Key Performance Indicators (KPIs) to assess MEMS performance across several areas. Information was gathered from 252 pieces of medical equipment at four different institutions. Expert judgement was used to determine face and content authenticity, and all characteristics showed agreement levels over 70%. Exploratory data analysis was used in the research to guarantee the correctness and dependability of the findings. The results showed that hospitals' performance varied significantly, with GMCH doing the best. Inadequate maintenance and malfunctioning equipment were also noted as problems with medical equipment management. The findings provide hospital managers and legislators practical advice on how to improve medical equipment management procedures, which will eventually improve the quality of healthcare.

Keywords: Medical Equipment Management System, MEMS, Performance Assessment, Public Hospitals, Key Performance Indicators, India

INTRODUCTION:

Research and talks on medical device management in various nations have been carried out by several experts from throughout the world. The variables impacting the administration and care of medical devices in military hospitals were the subject of a qualitative study by Amarion and colleagues. The journal Military Medicine issued a paper summarising his study. He surveyed a military hospital's administration and doctors and nurses using the framework analysis technique. The data is evaluated using semi-structured interviews, and the many aspects impacting medical device maintenance management are ranked according to frequency using descriptive statistics. According to the study's findings, device management training might make up a considerable chunk of that sum. Due to the limited sample size, it was inevitable that they considered the likelihood that the findings may impact other individuals (Ajmera et al., 2014). Integrated facilities management systems have been assessed by Ms. Ulickey for a considerable number of complicated scenarios. In the past, many different control techniques could be integrated thanks to networking and the growth of digital control systems. A number of control strategies were used to accomplish this. Both healthcare facility management and building systems may benefit from these approaches. Utilising existing resources becomes simpler as scientific understanding expands, leading to a more solid mathematical basis for the rational use of various medical technology. The future should revolve on studying how to correctly assess this data and improving the system's capacity to provide informed planning judgements.

U.S. hospitals are allocating more resources towards tracking and repairing their medical equipment as a result of recent technological and scientific advances. One of the most crucial parts of modern hospital IT infrastructure, says Qiang, is the availability of cutting-edge medical equipment. As a result, the hospital has to establish a reliable system of administration, keep an eye on the maintenance of medical equipment to make sure it's running well, and make sure everyone who works there and visits is safe. A number of methods, such as literature searches, surveys, questionnaires, and data analysis, have been used to summarise the following: the characteristics and development of the maintenance management model; the current situation in Germany and abroad; and the maintenance and management of hospital medical devices (Chien et al., 2010). Data collection and analysis were carried out using these techniques. But it didn't back up its assertion that smart medical device management systems could be built with the help of the Internet as it is now. He made this claim without providing any proof. In addition, it failed to provide any evidence to back up its assertions that the advantage had been shown in certain field investigations.

RESEARCH METHODOLOGY:

Empirical, descriptive, and analytical methods were used extensively throughout the investigation. All four of Raipur City's public hospitals were included in the probe. Over the course of three years, the research will be conducted. The research techniques were validated by considering the perspectives of physicians, technical managers, biomedical managers, and academics who are specialists in hospital management.

The purpose of this study was to choose 252 items of medical equipment from four public hospitals to gather data on the use of certain MEMS key performance indicators. In order to build a measurement instrument, the study team solicited the experts' thoughts and views to gather primary data. The second portion of the research, the application phase, included collecting primary data using questionnaires and in-person observations. The data came from doctors and nurses who were in charge of the medical equipment and its use.

By perusing all of the hospital records and documentation pertaining to MEMS, we were able to get the secondary data for the previous year.

A self-administered, structured questionnaire was considered for data collection from medical equipment administrators and users.

Researchers used inferential and descriptive statistics. Finding the frequency distribution and the threshold of significance for testing hypotheses were among them. In addition, hypotheses were tested using one-way analysis of variance (ANOVA), multiple linear regression models, Pearson's correlation coefficients, and simple linear regression analysis.

DATA ANALYSIS:

Expert Agreement Overview:

The experts' summarised % agreement is shown in Figure 1. An overview of the whole scale's thorough % agreement is given in Table 1. The following agreement percentages were assigned to the five evaluated attributes: Timely (87.1%), Relevant (93%), Measurable (85.2%), Achievable (85.6%), and Specific (91%). Expert consensus was confirmed by each characteristic exhibiting an agreement level over the 70% threshold. Subjective expert judgement was used to establish the instrument's face and content validity. The experts also offered feedback on how the suggested KPIs might be categorised under relevant topics and viewpoints.

Table 1: Expert Percentage Agreement

Attribute	Specific	Measurable	Achievable	Relevant	Timely
Strongly Disagree	0	0	0	0	0
Disagree	2.1	2.5	1.7	1.5	1.9
Can't Say	6.9	12.3	12.7	5.6	11
Agree	42.9	46.9	46	41.7	52.3
Strongly Agree	48.1	38.3	39.6	51.3	34.8
Percentage Agreement	91%	85.20%	85.60%	93.00%	87.10%

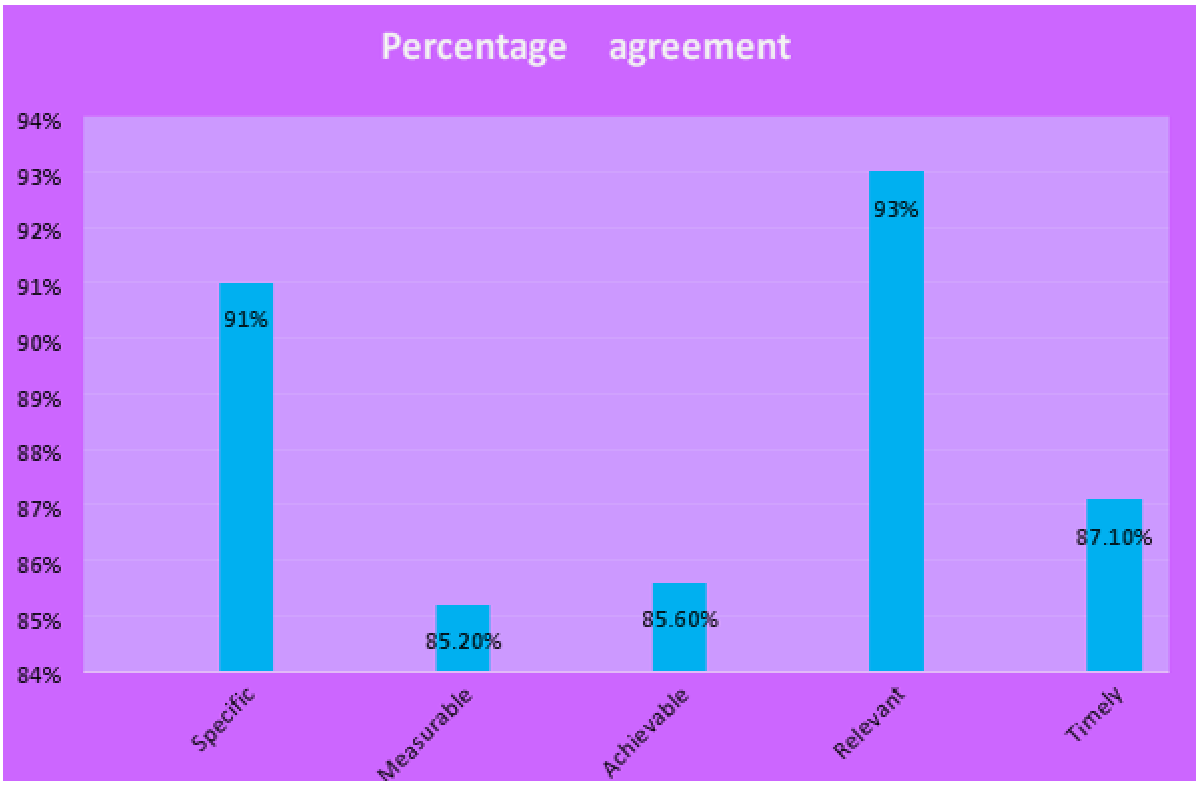

Figure 1: A Comprehensive Percentage Agreement amongst Experts

Selection and Description of Study Units:

Chapter 3 lays out the sample criteria that were used to include 252 pieces of medical equipment from four public hospitals in the study. Notably, 108 pieces originated from GMCH, 72 from GMSH, and 36 from CH-22 and CH-MM. Two parts from GMCH, five from GMSH, three from CH-22, and three from CH-MM were found to be non-functional out of a total of thirteen. The selected KPIs could not assess data for non-functional elements, so GMCH had 44.4% valid data, GMSH 28.0%, and CH-22 and CH-MM 13.8%. Table 2 contains the study units' descriptions and selection criteria.

Table 2: Study Units Description

Hospital	GMCH-32	GMSH-16	CH-22	CH-MM	Total
Frequency	108	72	36	36	**252**
Missing	2	5	3	3	**13**
Percentage Sample Size	42.80%	28.60%	14.30%	14.30%	**100**
Valid Percent	44.40%	28.00%	13.80%	13.80%	**100**
Cumulative Percent	42.90%	71.40%	85.70%	100.00%	

Descriptive Statistics of Medical Equipment Performance:

Table 3 uses input, process, output, and result KPI ratings to summarise the descriptive data of medical equipment performance across four hospitals.

Table 3: Descriptive Statistics

Statistic	N (Valid)	Missing	Mean	Standard Deviation	Minimum	Maximum
Input KPI Score	239	13	22.26	2.591	15	28
Process KPI Score	239	13	17.22	3.711	8	25
Output KPI Score	239	13	12.79	1.954	7	16

Outcome KPI Score	239	13	17.68	4.267	6	24

Hospital Performance Analysis:

Based on each of the four conceptual framework domains, Figure 2 shows the % mean performance for each of the four hospitals. This image also shows the hospital's performance rating in each area. A thorough summary of the 28 chosen KPIs' % success across all hospitals is also shown in Figure 3.

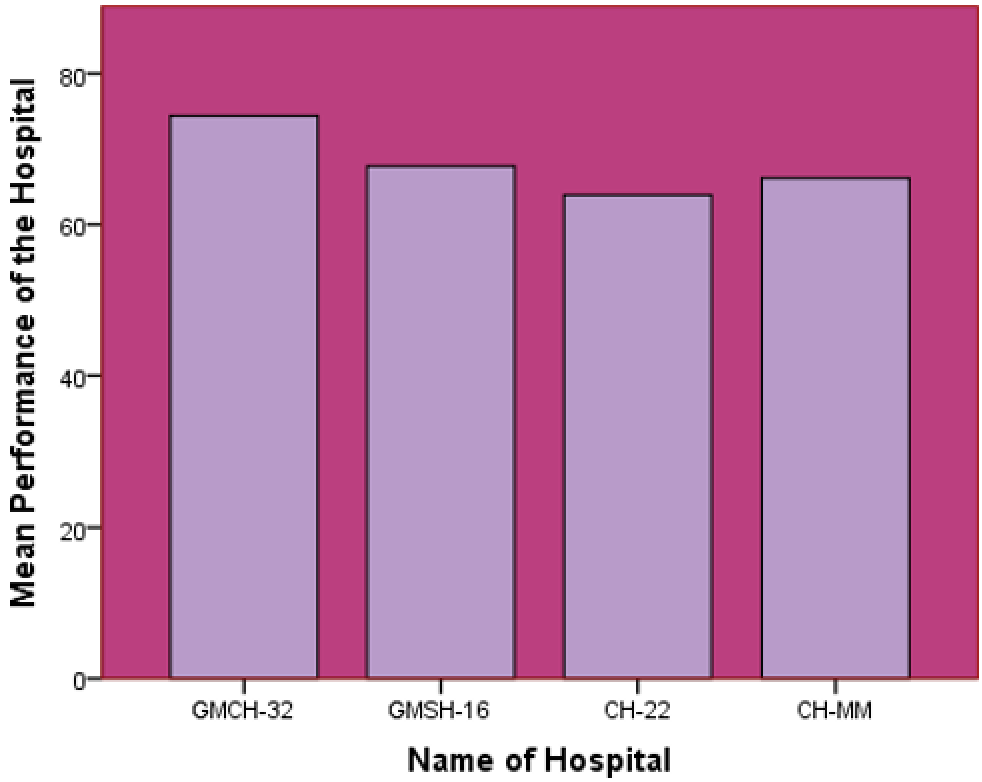

Figure 2: Percentage Mean Performance of the Hospitals

Figure 3: Percentage Performance: Four Domains

Exploratory Data Analysis:

Before testing any hypotheses, the distribution and characteristics of the % performance data were examined using exploratory data analysis. The descriptive statistics, together with the means, variances, and standard deviations, for each institution are shown in Table 4. Table 5 shows the results of the tests for normality, skewness, and kurtosis, as well as the Shapiro-Wilk and Kolmogorov-Smirnov tests.

Table 4: Descriptive Statistics - Performance Data

Statistic	Mean	95% Confidence Interval	Variance	Standard Deviation	Skewness (SE)	Kurtosis (SE)
GMCH	74.42	72.52-76.31	97.293	9.864	-0.407 (0.235)	-0.049 (0.465)
GMSH	67.75	65.06-70.43	121.404	11.018	-0.353 (0.293)	-0.962 (0.578)
CH-22	63.91	60.30-67.52	103.773	10.187	-0.180 (0.409)	-1.379 (0.798)

CH-MM	66.12	62.29-69.96	117.047	10.819	-0.310 (0.409)	-0.796 (0.798)

Table 5: Test of Normality

Hospital	GMCH-32	GMSH-16	CH-22	CH-MM
Kolmogorov-Smirnov (K-S)	0.115 (p=0.001)	0.100 (p=0.095)	0.115 (p=0.200*)	0.125 (p=0.200*)
Shapiro-Wilk (S-W)	0.953 (p=0.001)	0.952 (p=0.011)	0.925 (p=0.026)	0.954 (p=0.041)

CONCLUSION:

A trustworthy measurement instrument to evaluate MEMS performance in Indian public hospitals was successfully created and verified by the research. The method proved to be successful in identifying hospitals' strengths and opportunities for development via data analysis and expert validation. Significant differences in equipment management were found in the results, highlighting the need of effective maintenance plans and more efficient use of available resources. Better equipment management procedures were seen in hospitals with higher KPI ratings, indicating a clear connection between operational effectiveness and methodical management. In order to improve medical equipment management and guarantee better patient safety and healthcare service delivery, policymakers and healthcare managers are urged to use the suggested evaluation instrument. By adding more factors and extending its use over a wider sample of hospitals, future study might improve the tool even further.

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